

RESTRICTED CIRCULATION

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OPTIMUM SOWING DATES FOR WINTER WHEAT

Standard agricultural texts eg. Duckham (1963) suggest that winter wheat is sown from mid-September to December, but that the majority is sown in the latter half of October. Summaries of date of sowing experiments (eg. McClean, personal communication (1981)) show that sowing after the end of October usually causes a reduction in yield. However, the position is less clear for September sowings since sometimes the yield is increased and sometimes decreased from the yield from an October sowing.

Croxall and Smith (1965) and Smith (1975) attempted to show that there was an optimum sowing date for winter wheat. The 'rule' which was formulated states that the optimum time lies between 10 and 45 days after the first date on which the 9 am soil temperature at 10 cm depth falls to 12.8°C . Since the date of first fall to 12.8°C is usually in the first 3 weeks of September we can see why October stands out as the best month for sowing.

This approach can be criticized on several counts:-

1. The amount of data for early sowings (mid-September or earlier) is very limited, so that there is very little information to define the optimum, if one exists.
2. The wheat was one variety Cappelle Desprez, usually grown as a first wheat after a 3 year ley. This variety now occupies a very small area nationally, and it is possible that modern wheats do not behave in the same way in continuous cereal systems.
3. The trials that Croxall and Smith used were between 1957 and 1960 when treatments for weeds and diseases were not as advanced as they are now.

The purpose of this note is to report a test on the Croxall-Smith method which uses recent data, mainly from EHF's. The technique used was to note the date at which the 10 cm soil temperature measured at 9 am first fell to 12.8°C . The number of days from this date to the sowing date was noted together with the grain yield. Trials were used which had the same treatment, or nearly so, for all sowings and results are presented in graphs for each EHF. In these graphs the horizontal axis shows the number of days to the sowing date from the date of first fall to 12.8°C (10 cm soil temperature). The yield (vertical axis) is shown as the drop in yield from the highest yield for the set of sowing dates. This method of presentation eliminates the effect of the absolute value of yield to a large extent, but is not good for an experiment which only had late sowings for example, since this would tend to expand the number of points on the 'yield drop = 0' axis. This method of presentation was chosen since it can be compared directly with that in Smith (1975).

Test of the method at the EHF's

Bridget's EHF - (Figure 1)

A 3 year experiment was undertaken from 1972 to 1974 with varieties Cappelle,

Ranger, Huntsman, Bouquet, Atou and Freeman. The range of sowing dates defined the optimum yield in each year. Figure 1 shows there is no clear relation. Where it was obvious from the trial notes that severe weed infestation or disease were depressing the yield then these points were omitted in figure 1.

Arthur Rickwood EHF

Yule (1980) reported the results of a date of sowing experiment which was done in the 3 years 1976 to 1978. The cultivars were all modern: Huntsman, Atou, Bouquet and Hobbit. The range of sowing dates did not unfortunately include September. Yule's results are given in figure 2, and those for the EHF (including Yule's results) are given in figure 3. Yule's results (fig. 2) show that there is a definite trend to poorer yields with late sowing, with the yield decline starting after 35 to 40 days. Smith (1975) suggests the yield decline begins after 45 days so that the agreement is fairly good on this point. There is not enough data on early sowings in figure 2 to decide if there is an optimum.

In figure 3 all the EHF data is grouped, and the result is far less promising. There is a tendency for the worst yields to be after 60 days.

High Mowthorpe EHF

In figure 4, a wide range of sowing dates are represented, though with only a few before 30 days and after 100 days. This graph suggests that yield is optimum from sowings between 30 and 90 days with a decline in yield for very early or very late sowings.

High Mowthorpe frequently has the first occasion with the 10 cm soil temperature dropping to 12.8°C, in August. Application of the standard rule therefore gives a large number of days to the sowings. It is interesting to note that if 30 days or so were subtracted, then the optimum sowing date would be between 0 and 60 days which is more in keeping with Smith's figures of 10 to 45 days.

Gleadthorpe EHF

In figure 5 there is a tendency for later sowings to have lower yields. The best yields lie between 20 and 50 days, in fair agreement with Smith's figures, but there is no evidence of a decline in yield for the single very early sowing.

Other Results

A one year trial with Huntsman at Drayton EHF showed no variation in yield for sowings at 39 or 61 days.

At Terrington EHF a 2 year date of sowing experiment (MAFF 1981) showed that early October sowing gave higher yields than early November sowing.

Holderness

Figure 6 shows results for the 3 years 1978-1980 at various sites in Holderness (B. Beaney, personal communication, 1981). Values of 10 cm temperatures were not available and had to be estimated from 30 cm readings measured at Hull. On medium to heavy soils the 30 cm temperature falls to about 14.2°C when the 10 cm temperature falls to 12.8°C and this was used to estimate dates for these sites. These results are remarkable for the very rapid fall of yield as the number of days increases. No optimum period for sowing can be seen, with the very early sowings (in September) giving the highest yield.

Some Possible Interactions Between Sowing Date and the Weather

Smith (1975) claimed that there would be an optimum sowing date for winter wheat

because crops sown before the optimum time would be too "proud", while those sown too late would make insufficient growth before the winter. These reasons are in part based on the idea that wheat does not grow at temperatures below 6°C, whereas it is now generally accepted that the threshold temperature for growth is nearer 0°C. Therefore, wheat grows slowly during the winter and the idea that the plants must reach a particular stage to be "ready for the winter" is perhaps less important in Britain than it is in continental areas with severe winters.

Early sowing will do two things to wheat: one is to cause the plants to develop to a more advanced development stage before the colder weather slows growth, and the second is to produce plants with perhaps five or ten times the dry weight of late October sown plants, by late November. Some possible weather related reasons why high dry weight crops could be at a disadvantage include:-

1. Wind damage. Heavier, more advanced crops would be taller and therefore at greater risk during strong winds.
2. Heavy crops have a larger maintenance respiration requirement. It is possible that plants could lose dry weight if respiration exceeded gross photosynthesis. By using the methods of Agricultural Memorandum 892 a comparison can be made of respiration and photosynthesis in mid-winter for early sown crops (dry weights 0.6 and 1.0 t/ha, leaf area indices 0.8 and 1.3) and 'normal' crops (dry weight 0.2 t/ha, leaf area index 0.25). The table shows the results of the calculations. Maintenance respiration R has been calculated at two temperatures 5 and 10°C for the three dry weights 0.2, 0.6 and 1.0 t/ha. Gross photosynthesis G, has been calculated less the amount of synthesis respiration r ($= 0.34 G$). $G-r$ is given when the leaves are photosynthesising near their maximum rate, and for a more average rate. It is assumed that temperature has no effect on photosynthesis rates. This may not be true, particularly at 5°C. Photosynthesis was calculated for Agroclimatic Area 12 (The Vale of York), during December when the daylength is 8.9 hrs and sun hours average 1.2 hrs/day.

The table shows that all crops from the lightest to the heaviest would be comfortably in positive balance even during mild spells, with therefore higher maintenance respiration rates, in December. Even the more average rates of $(G-r)$ are about three times maintenance respiration at 10°C, although the heaviest crop does have a slightly lower ratio of $(G-r)$ to R. It is likely that photosynthesis could be reduced to about one third the maximum value at 5°C, but even then R is exceeded by $G-r$.

A heavy crop might be in danger if the photosynthesis rate was considerably reduced because of pest or disease attack brought about due to early sowing. Defoliation due to wind or shrivelling of the leaves due to frost injury would be detrimental. For example if the 1 t/ha crop lost leaves so that the leaf area index changed from 1.3 to 0.25 without the dry matter changing much, then at 10°C a value of $R = 6.0$ Kg/ha/day might be accompanied by $G-r = 3.9$ Kg/ha/day which implies a fairly rapid wasting away of the crop ($R/(G-r) = 1.5$).

However, a crop with leaf area index 0.25 which suffered the same proportional loss of leaf has $R/(G-r) = 1.7$. Therefore it seems that lighter crops could be in greater danger due to defoliation than heavier crops. This supports the view that late sowing is detrimental.

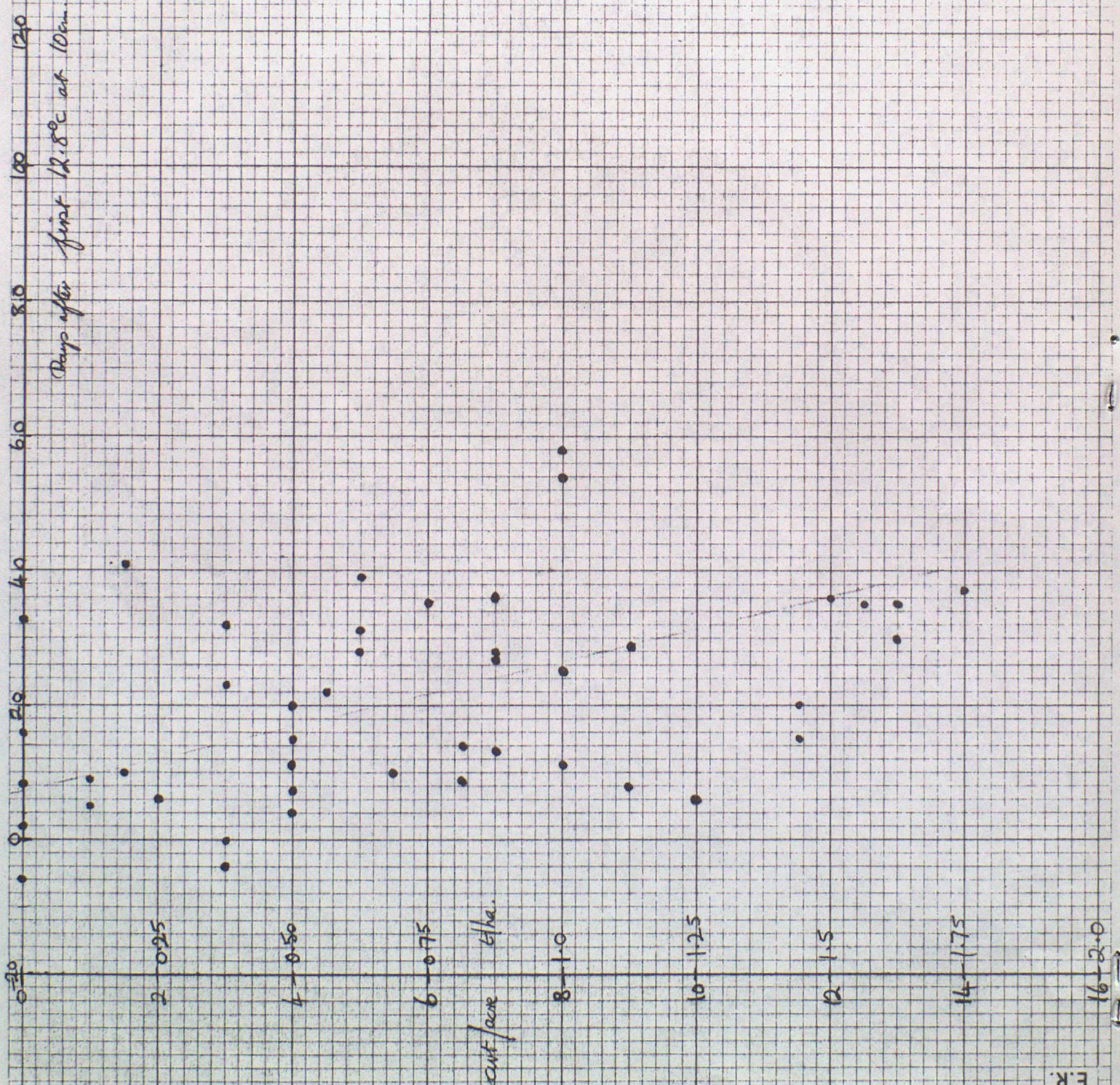
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Table showing values of maintenance respiration R (kg/ha/day) and gross photosynthesis G less synthesis respiration r (both Kg/ha/day) for different dry weights and temperatures.

Mean daily Temperature ($^{\circ}\text{C}$)	Maintenance Respiration R (Kg/ha/day)		Gross Photosynthesis - Synthesis Respiration G-r (Kg/ha/day)	
	5	10	Best	Probable average
Dry weight (t/ha) 0.2	0.85	1.2	4.8	3.9
0.6	2.6	3.6	13.9	11.4
1.0	4.2	6.0	20.8	17.0

HOLDERNESS, FK 6.

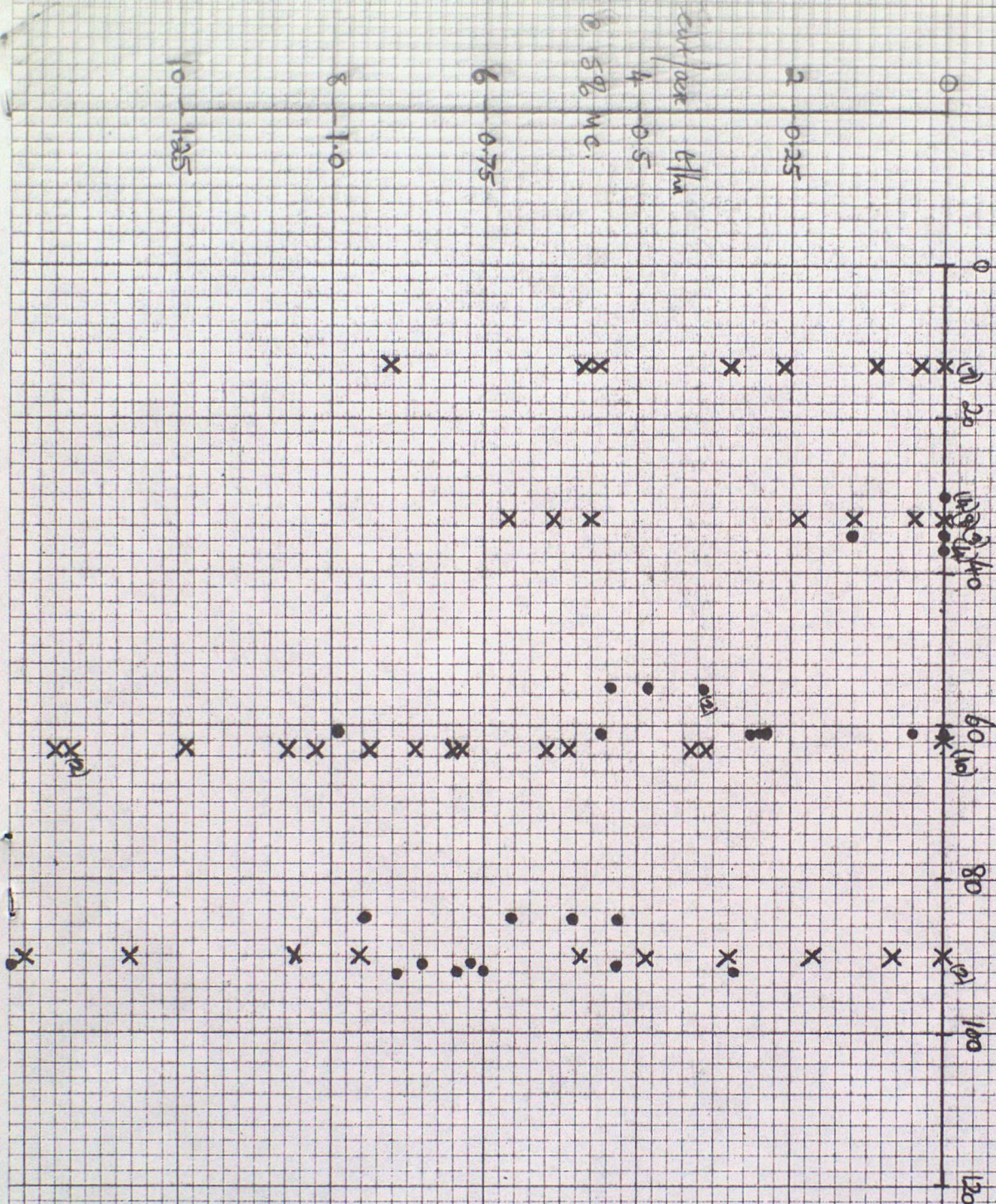


ARTHUR RICKWOOD E.H.F.

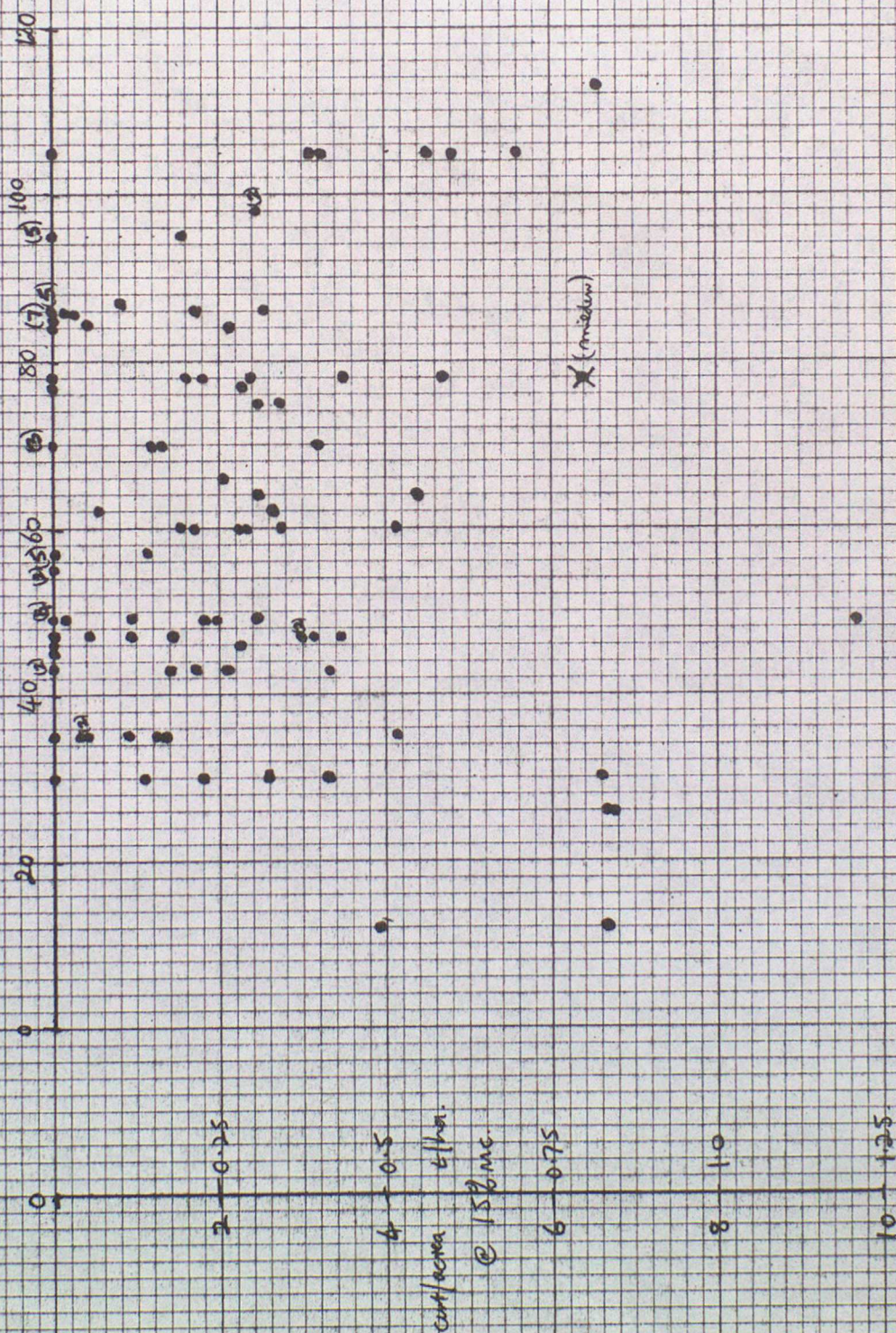
Yule's experiment 1976-1978

F/6.3

Days after first 12.8°C at 10am.



Days after first 12.8°C at 10am.



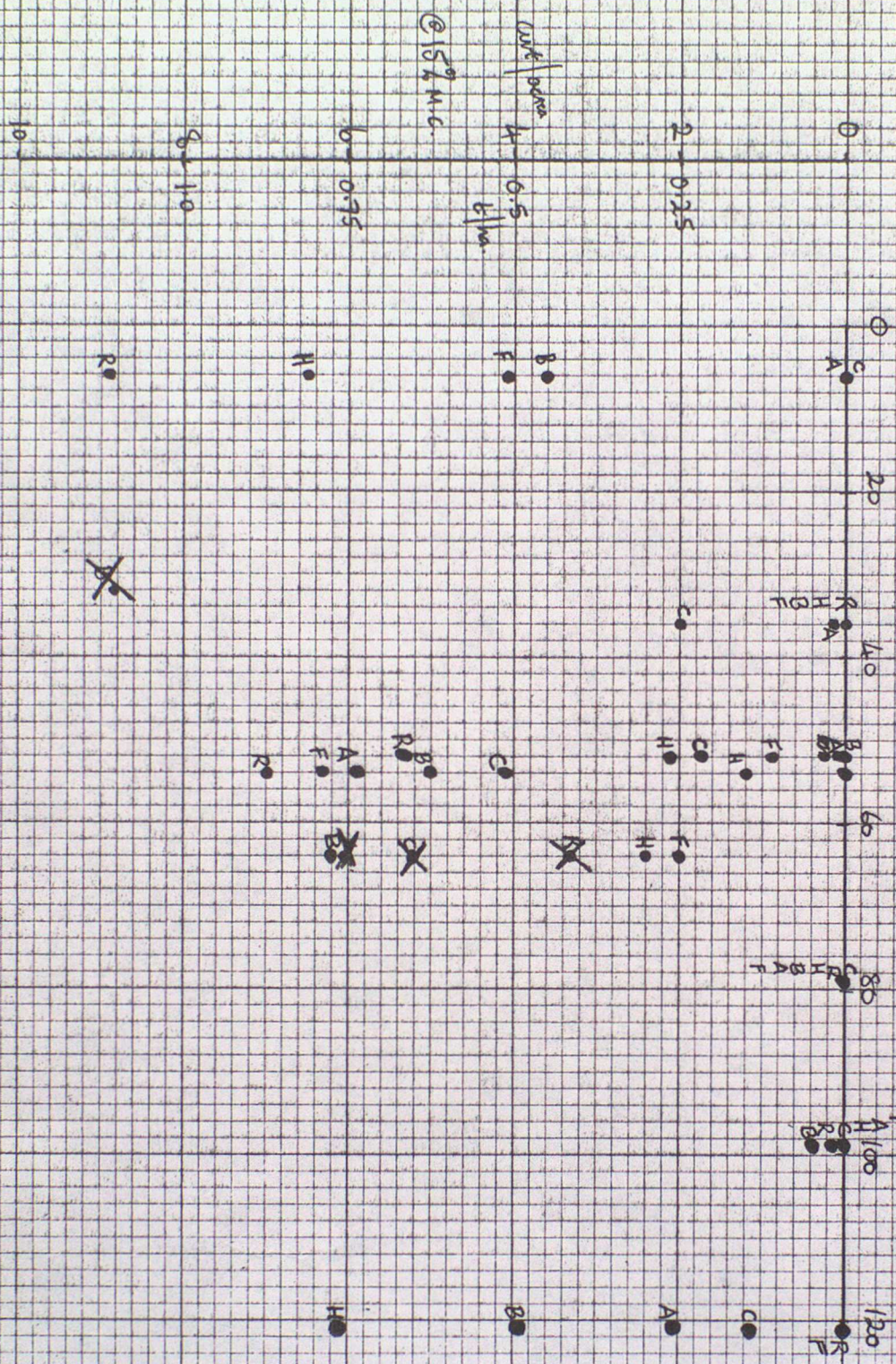
BRIDGET'S EMT.

FIG. 1

- C = Coyote
- R = Ranger
- H = Huntsman
- B = Boudier
- A = Owl
- F = Fox

X Weeds or disease known to decrease yield.

Days after first frost 12.8°C at 10am



E.R.

R. 12.8°C at 10am

YULE'S EXPERIMENT 1976-78

Day after first 12.8° at 10am.

